Atmospheric
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Discussions

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Interactive comment on "Country-scale greenhouse gases budgets using shipborne measurements: a case study for the United Kingdom and Ireland" *by* Carole Helfter et al.

Anonymous Referee #1

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Summary/General comments: Helfter et al. present observationally derived fluxes of CO2 and CH4 for the United Kingdom and Ireland using multiple years of shipborne observations and a mass balance approach. The authors have collected a unique dataset in making ferry based measurements downwind of an island nation and this has facilitated the application of a simple mass balance approach to evaluate national level fluxes of greenhouse gases. This is an interesting and valuable contribution to the scientific literature and well placed in ACP. I do have some questions and points of clarification that are needed, in particular some expanded discussion of uncertainty, and these are highlighted below. Once these issues have been addressed publication in ACP would be warranted.

C1

Major comments: My largest complaint is that I would like to see more explanation and detailed information on the uncertainty assessment. While uncertainties are derived for all the mass balance estimates, I would like to see more explanation of how these were derived and inclusion of quantitative measures of uncertainty for all the components that make up the final uncertainty. I would also like to see discussion of what is included and what possible errors are excluded from these uncertainties. One issue in particular I would like to see more on is the estimates and assumptions of planetary boundary layer depth. In the mass balance approach applied there are assumptions of tracers being well-mixed in the planetary boundary layer and the height of this layer remains stable in time. First, it is better to use the term mixed layer as though often synonymous with pbl it isn't always the same. My understanding is the mixing layer was extracted from WRF and averaged over the history of the particle travel. What were these values? How much variance in pbl depth occurred in this time (as a proxy for uncertainty). How were these pbl heights evaluated and how do we know a bias isn't present? How does the model do at representing mixing layers over the ocean, where the measurements were made? Are local sea-breeze effects important? Is the pbl not changing over the course of the full downwind transect of the boat? If it is changing how is that dealt with? How can observations be safely used at any time of day? In airborne mass balance observation need to be midday when sufficient mixing within the pbl can be established and the pbl thickness is not changing dramatically?

So I would like to see generally more information on uncertainty, and specifically a more detailed discussion, quantitative analysis, explanation and justification of the approach regarding mixing depths and assumptions therein.

Minor comments: Page 2 Line 9-11: This is misleading as a number of other papers have shown the possible role of OH (Turner et al., PNAS; Rigby et al., PNAS) and roles of fossil/fires (for example Wordern et al., GRL).

Section 2.1.1 Is there filtering of potential contamination of stack air and/or passenger influenced air? If not, how justified? If so, how is the filtering done?

C2

Was the H2O correction for the Picarro validated/calibrated?

Section 2.2.3 See above regarding PBL questions

Page 5 Line 35: Please tell us what these mean travel times are and their variance.

3.2 Diurnal variability: Are these defined by observation time or by flux time? I'm concerned about the use of data not during well mixed conditions, and what transects may show during time of pbl growth and collapse. Also, how do we know that night measurements are not missing a large outflow occurring above the stable surface layer?

Inventories are mentioned but never really discussed in any detail. More explanation of the inventories and what is included/excluded would be valuable.

Page 8 line 18: repeating point c

Page 10 line 12 : state here explicitly this implies the biosphere accounts for the difference as opposed to saying cannot compare with the inventory. Could also mention with biospheric model and/or constraints could directly compare.